GAME THEORY

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WHEN
DO WE PLAY A GAME?

Decide what is a game or not:

- **Driver maneuvering in a heavy traffic.** — **driving game**
- **Bargain-hunters bidding on eBay.** — **auctioning game**
- **A firm and a union negotiating next year's wage.** — **bargaining game**
- **Candidates choosing their platforms in an election.** — **political game**
- **The owner of a grocery store deciding today's price for corn flakes.** — **economic game**

A GAME IS BEING PLAYED

WHENEVER HUMAN BEINGS INTERACT.

GAME THEORY APPLICATION

- Game theory might be applied to predict how people play any game of social life.
- But game theory can't solve all of the world problems.

- Game theory only works when people play ***rationally***.

THE THEORY OF RATIONAL CHOICE

- A decision-maker chooses the best action according to his/her preferences among all the actions available to him/her.
  - action set *A*:
    - all the **available actions** to decision-maker
    - a **specification of** decision-maker's **preferences**
  - we assume consistent preferences: $a > b, b > c \Rightarrow a > c$

The action chosen by a decision-maker is at least as good, according to her preferences, as every other available action.

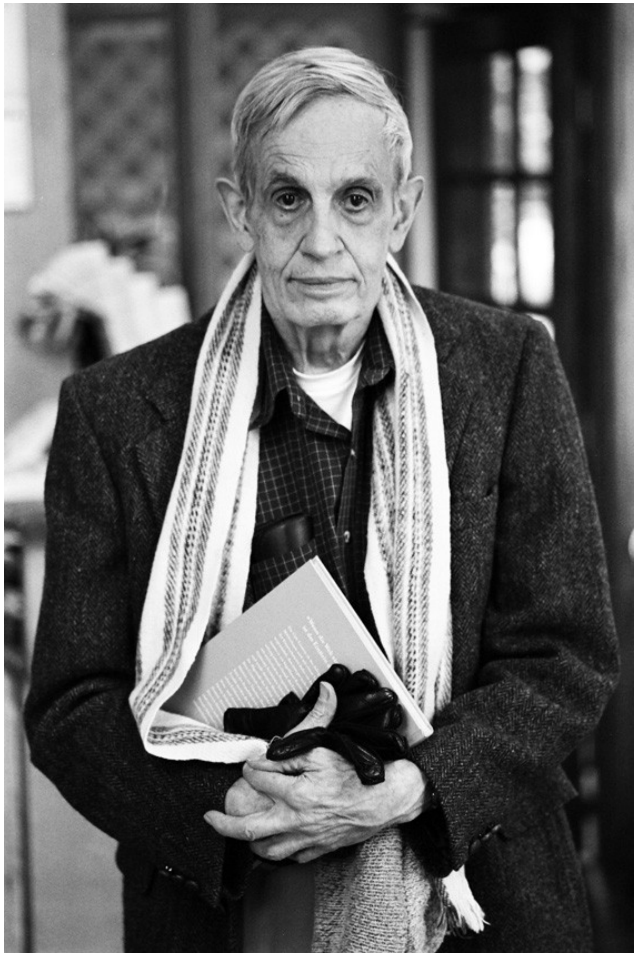
LET'S PLAY SOME GAMES

- Matching Pennies
- Prisoner's Dilemma
- Battle of the Sexes

"They've led our breakthroughs in gaming theory."

NASH EQUILIBRIUM

- Occurs when all players are simultaneously making a best reply to the strategy choices of the others.



MATCHING PENNIES

Alice and Bob each show a coin.

Alice wins if both coins show the same face.

Bob wins if they show different faces.

		BOB	
		heads	*tail*
ALICE	*heads*	+1 -1	-1 +1
	tails	-1 +1	+1 -1

TRADITIONAL PRISONER'S DILEMMA

Alice and Bob are Gangsters in Chicago.

The District Attorney knows that they are guilty of a major crime, but is unable to convict either unless one of the confesses.

He offers each a following deal:

- If you confess and your accomplice fails to confess, then you go free.
- If you fail to confess but your accomplice confesses, then you will be convicted and sentenced to maximum term in jail (10 years).
- If you both confess, then you will both be convicted, but the maximum sentence will not be imposed (9 years).
- If neither confesses, you will both be framed on a tax evasion for which conviction is certain (1 year).

TRADITIONAL PRISONER'S DILEMMA

		BOB	
		defect	*cooperate*
ALICE	*defect*	-9; -9	-10; 0
	coop.	0; -10	-1; -1

UPGRADED PRISONER'S DILEMMA

Alice and Bob have access to a pot of money.

Both are independently allowed to give their opponent \$2 from the pot, or put \$1 into their pocket.

		BOB	
		give	*take*
ALICE	*give*	\$2; \$2	\$0; \$3
	Take	\$3; \$0	\$1; \$1

NASH EQUILIBRIA OF PRISONER'S DILEMMA GAME

		BOB	
		defect	*cooperate*
ALICE	*defect*	-9; -9	0; -10
	coop.	-10; 0	-1; -1

		BOB	
		give	*take*
ALICE	*give*	\$2; \$2	\$0; \$3
	take	\$3; \$0	\$1; \$1

BATTLE OF THE SEXES

Alice and Bob plan a Friday evening together.

Alice likes ballet twice as much as rugby.

Bob likes rugby twice as much as ballet.

Neither Alice or Bob want to spend the evening without the other.

$$u^A(ballet) = 2$$
$$u^A(rugby) = 1$$
$$u^B(rugby) = 2$$
$$u^B(ballet) = 1$$

BATTLE
OF THE SEXES

		BOB	
		ballet	*rugby*
ALICE	*ballet*		
	rugby.		

BATTLE OF THE SEXES

		BOB	
		ballet	*rugby*
ALICE	*ballet*	2 ; 1	0 ; 0
	rugby.	0 ; 0	1 ; 2

WHAT TYPES OF GAMES THERE ARE?

- **Cooperative/Non-cooperative**
- **Symmetric / Asymmetric**
- **Zero-sum / Non-zero-sum**
- **Simultaneous / Sequential**
- **Perfect information / imperfect information**
- **Discrete and continuous games**
- **Infinitely long games**

GAMES

- **Matching Pennies**
  - simple game, no Nash equilibria
- **Prisoner’s Dilemma**
  - cooperation game, strong Nash equilibria
- **Battle of the Sexes**
  - coordination game, two pure (but unfair) Nash equilibria

WHY TO USE GAME THEORY?

I hope you know the answer ☺

LITERATURE

- Binmore, Ken. *Game theory: a very short introduction*. Oxford University Press, 2007.
- Binmore, Ken. *Playing for Real Coursepack Edition: A Text on Game Theory*. Oxford University Press, 2012.
- Osborne, Martin J. *An introduction to game theory*. Vol. 3. No. 3. New York: Oxford University Press, 2004.